

LA-UR-21-21762

Approved for public release; distribution is unlimited.

Title: Montage pit assessment of FY15 DE08

Author(s): Kaufeld, Kimberly Ann
Wendelberger, James G.
Kelly, Elizabeth J.

Intended for: Report

Issued: 2021-02-23

Disclaimer:

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by Triad National Security, LLC for the National Nuclear Security Administration of U.S. Department of Energy under contract 89233218CNA000001. By approving this article, the publisher recognizes that the U.S. Government retains nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

Montage pit assessment of FY15 DE08



Kimberly Kaufeld
Jim Wendelberger
Elizabeth Kelly



Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA

Montage (Stitched) Analysis for Zone 3 Sections 1-14 (Sub-subsections)

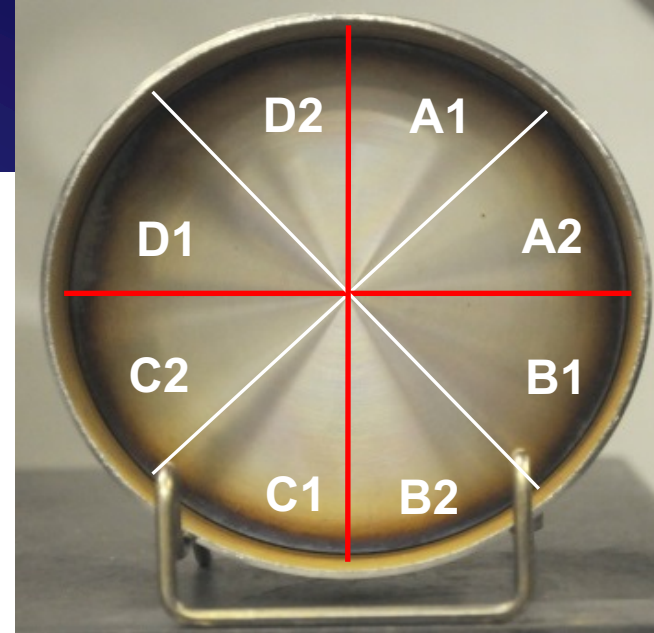
Four Sections: A-D (cut lid in quarters)

8 Subsections: A1 – D2 (cut section in half)

14 Sub-subsections in Zone 3: 1-14 (scanning areas set to reduce curvature)

4 Sub-subsections in Zone 1&2: a-d

One montage image per sub-subsection



Zone 3: 14 sections (sub-subsections)



Zone 1 & 2 : 4 sections (sub-subsections)

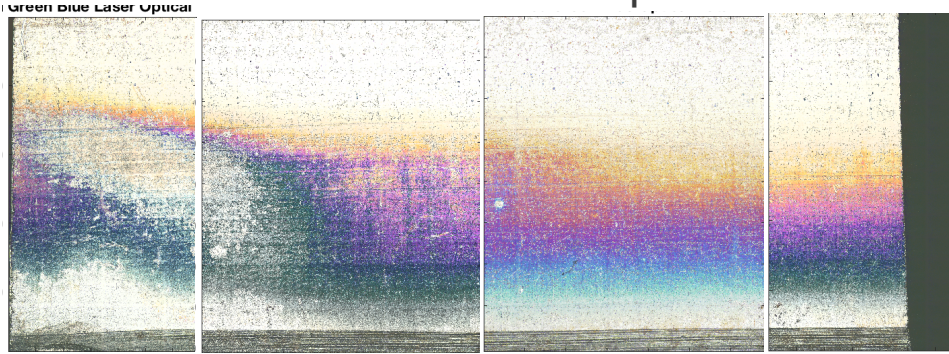
Montage (Stitched) Image versus 20X LCM images

- 20X LCM higher resolution than montage (stitched) images
 - 20X LCM pixel is 0.7 microns per side
 - Current montage specification results in pixels with between 2 and 5 microns per side
- Comparison to 20X LCM and Gwyddion analysis show that montage data analysis does a good job of capturing pit depths, area, volume and other statistics of interest

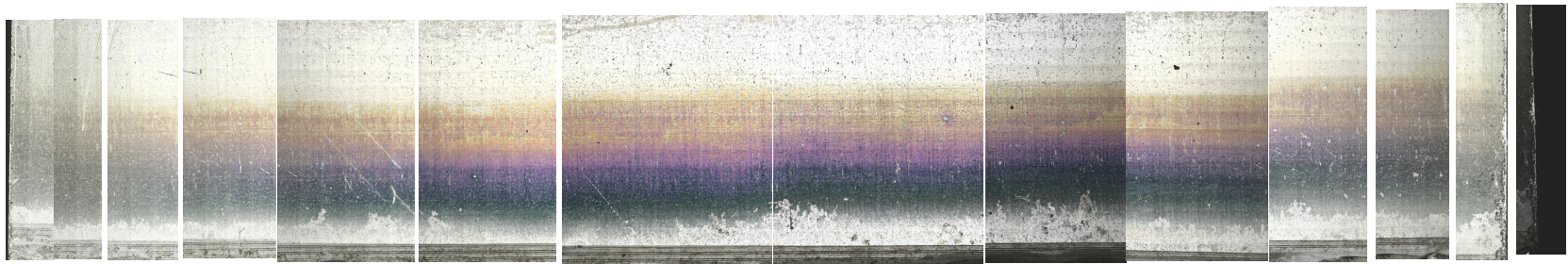
Automated Pit Analysis for FY15 DE08 Stitched Images

**For FY15 DE08 Section A2 was split into two sample groups due to cutting.
Due to this, it was evaluated separately**

A2 b Section 1-4: No areas with deep features when the edge was removed.



A2 a Section 1-14: The edge was removed.

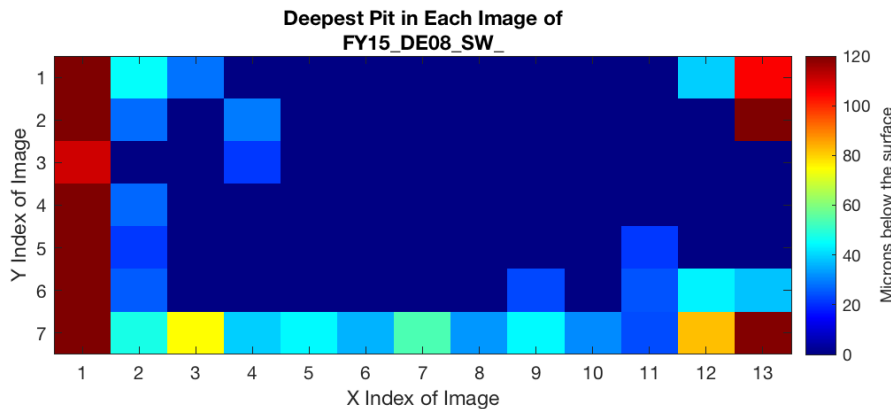


Feature Depth Summary for All Montages FY15 DE08

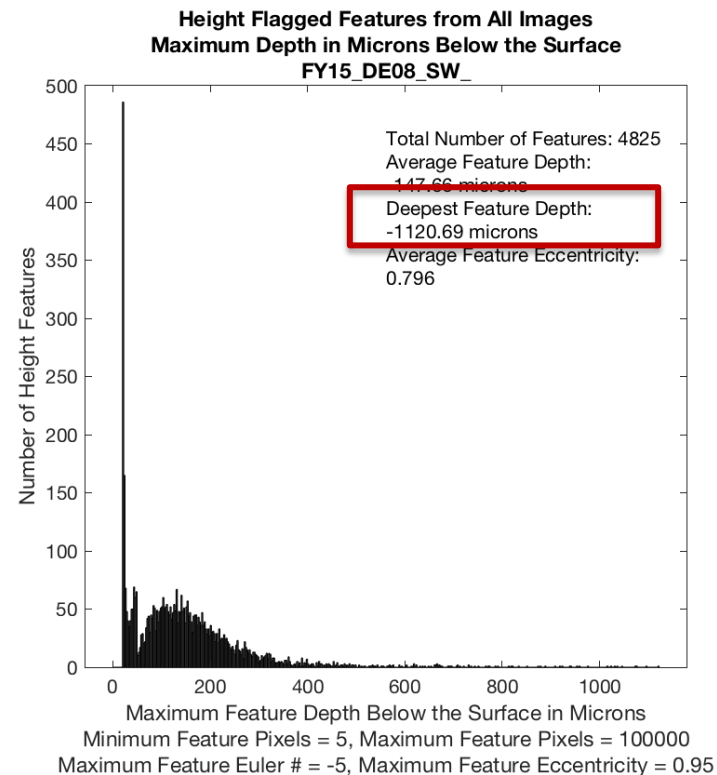
- FY16 DE 08 had Sections A1, A2, B1, B2, C1, C2, D1 and D2.
- Sections 1 and 14 are edges so were also taken out of the analysis. There were no features of interest on these images.
- Sub-sub section B1 section 14 did not exist.
- Section A2 was different than the other sections, so was analyzed separately.

Height Data - Summary for All Images FY15 DE08 Zone3

The depths are artifacts of the edge. The images that have depths of over 150 microns are edge images.

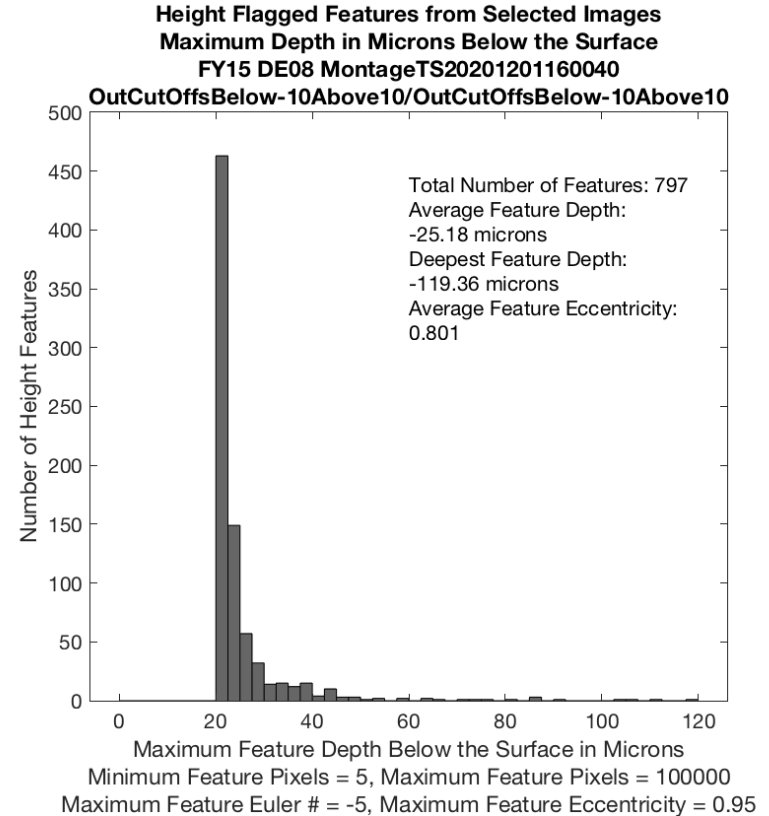
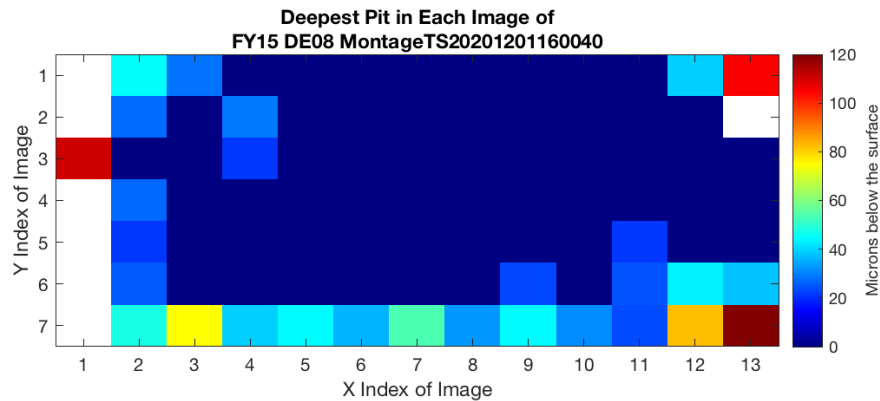


- Pit Depth Histogram - All Images



Height Data - Summary for Selected Images

FY15 DE08 Zone3



Pit distribution based upon depth and volume

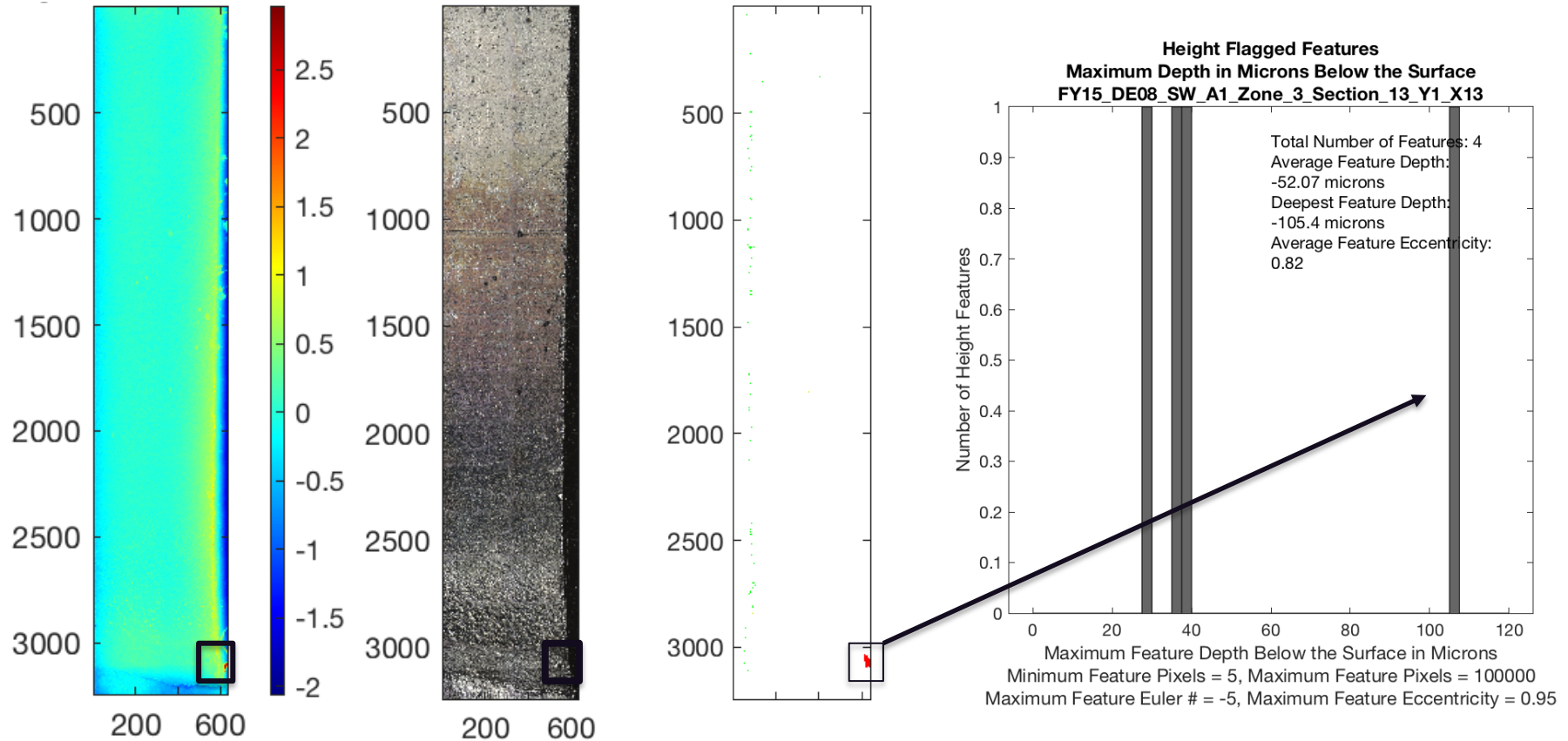
imagename	Rank Volume	Rank Pit Depth	NumPixel s	MaximumDepth hMicrons	LowVolumeMi cronsCubed	Equiv Diameter	CentroidRow	CentroidColumn
FY15_DE08_D2_Section_13.vk4	7	1	21	-119.35938	-13335.188	5.17088295	373.238095	18.6190476
FY15_DE08_B2_Section_1.vk4	5	2	124	-110.36629	-32856.943	12.5650986	8.77419355	49.8629032
FY15_DE08_A1_Section_13.vk4	1	3	1290	-105.40479	-269108.65	40.5275093	626.33876	3067.58682
FY15_DE08_D2_Section_12.vk4	6	4	112	-82.094572	-21519.137	11.9416426	548.964286	863.5625
FY15_DE08_D2_Section_3.vk4	8	5	42	-74.95149	-13122.468	7.31273279	72.9285714	1243.83333
FY15_DE08_A2_Section_13.vk4	2	6	866	-56.869345	-147215.58	33.2058044	596.779446	3232.88337
FY15_DE08_D2_Section_7.vk4	3	7	289	-53.787861	-126116.85	19.1824458	1024.07266	774.847751
FY15_DE08_D2_Section_2.vk4	9	8	22	-47.613451	-4930.9947	5.29256743	39.5909091	1389.59091
FY15_DE08_A1_Section_2.vk4	10	9	25	-45.426387	-2756.3208	5.64189584	240.32	1121.28
FY15_DE08_D2_Section_5.vk4	4	10	398	-44.473791	-59592.976	22.5110937	739.746231	1008.27638

The deepest pits are not always the ones with the greatest volume.

Flagged features

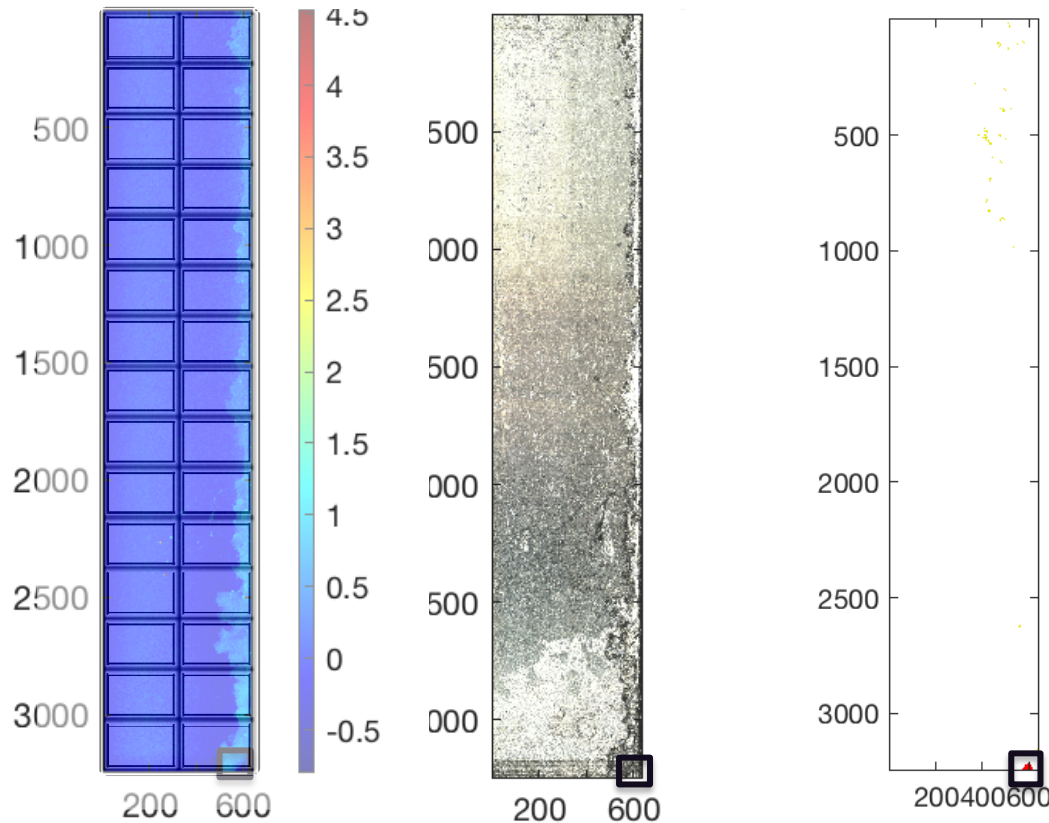
- The automated software flags features of interest as red, yellow, and green.
 - **Red features**: Depths 50 microns or more
 - **Yellow features**: Depths greater than 20 microns and less than 50 microns
(note these features are difficult to see on small plots)
 - **Green**: Depths less than 20 microns.
- Once the features are flagged by depth, they are ranked by volume to look at the largest features.

Montage A1 Section 13; Cubic volume ranking: 1, Deepest Pit Ranking: 3 Off sample image



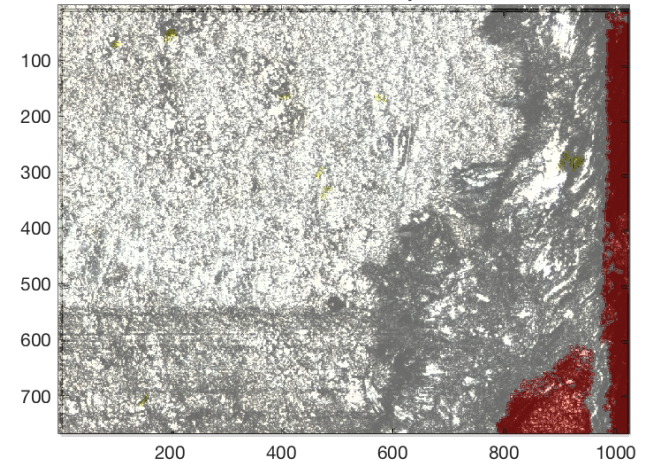
The large red feature (>50 microns) identified is off sample

Montage A2a Section 13: Cubic Volume ranking 2; Pit Ranking 6; Not a feature of interest edge

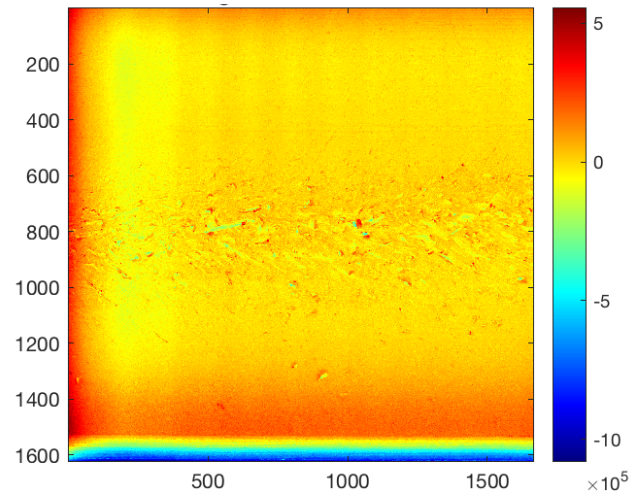


Analysis of the feature using individual 20x image. The feature of interest is in an area at the beginning of the edge.

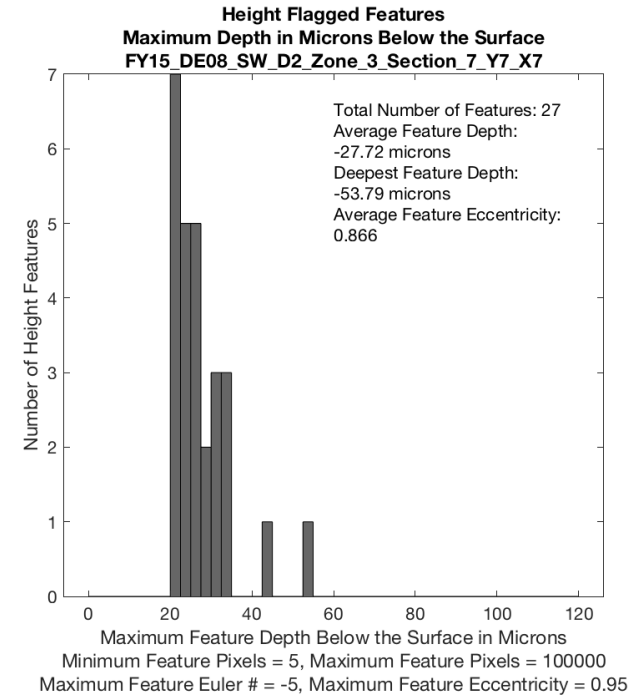
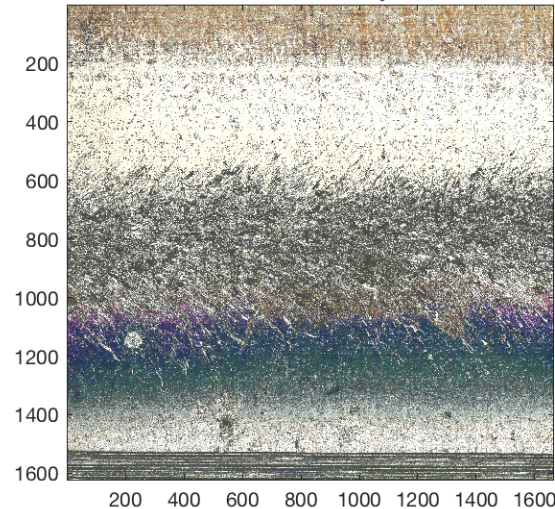
FY15_DE08_SW_A2a_Zone_3_Section_13_Y15_X2.vk4
Red Green Blue Laser Optical Data



Montage D2 Section 7: Cubic Volume Ranking 3, Deepest Pit Ranking: 7

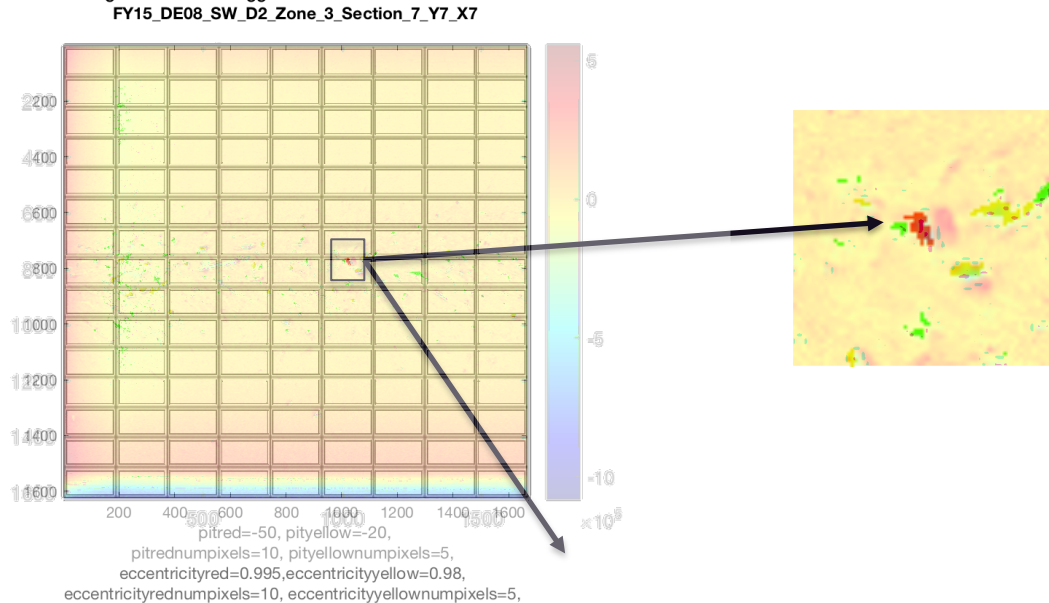


FY15_DE08_SW_D2_Zone_3_Section_7_Y7_X7.vk4
Red Green Blue Laser Optical Data

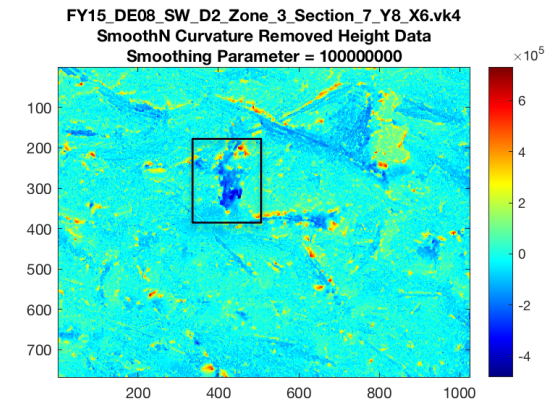
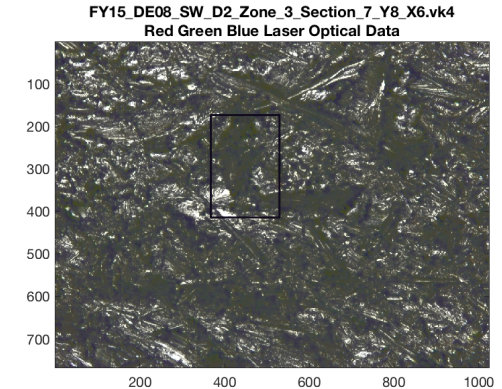


Detail view of D2 Section 7

The feature depth has a large area, but not too deep -53 microns.



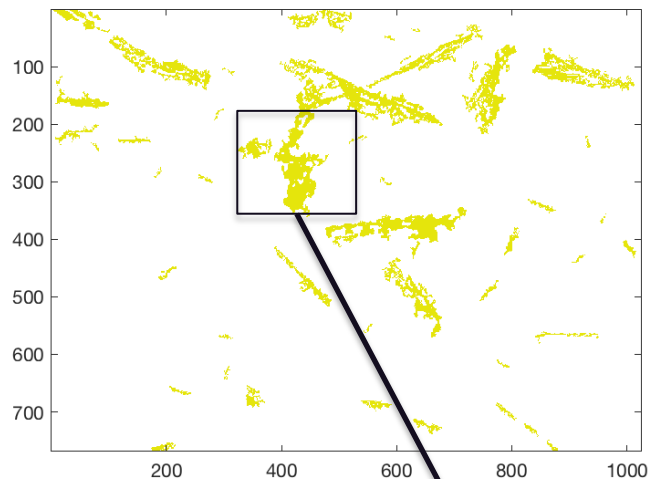
Individual 20x analysis of the feature



NumPixels	MaximumDepth	LowVolumeMicronsCubed	EquivDiameter	CentroidRow	CentroidColumn
289	-53.787861	-126116.85	19.1824458	1024.07266	774.847751

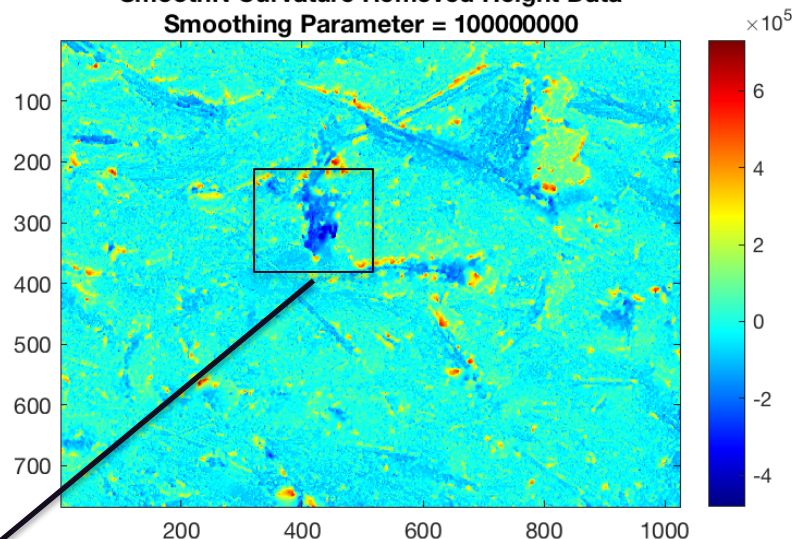
Individual 20x feature analysis of D2 Section 7

Height Flagged Features Below the Surface (Red or Yellow)
FY15_DE08_SW_D2_Zone_3_Section_7_Y8_X6



pitred=-50, pityellow=-30,
pitrednumpixels=100, pityellownumpixels=50,
eccentricityred=0.995, eccentricityyellow=0.98,
eccentricityrednumpixels=100, eccentricityyellownumpixels=50,
smoothparameter=1000000.

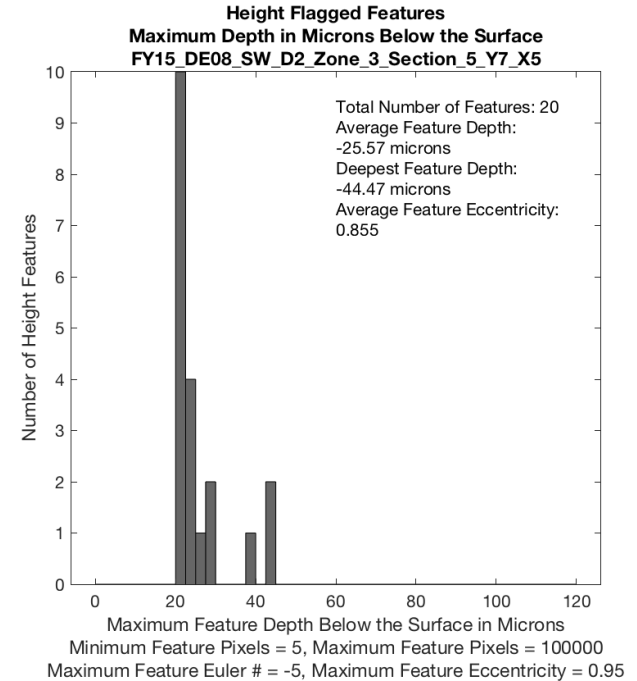
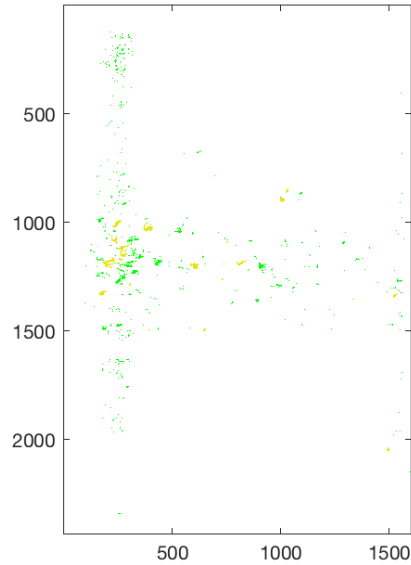
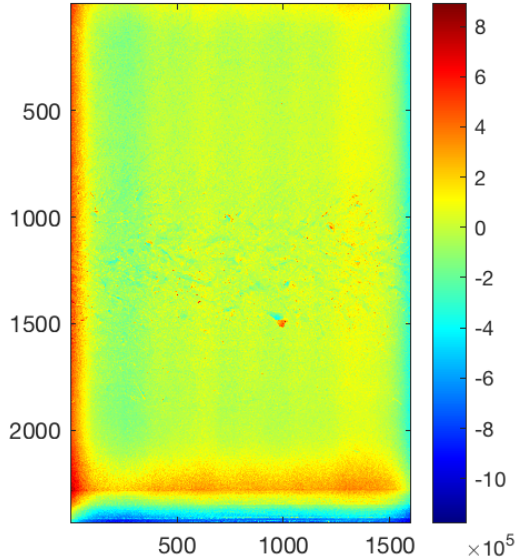
FY15_DE08_SW_D2_Zone_3_Section_7_Y8_X6.vk4
SmoothN Curvature Removed Height Data
Smoothing Parameter = 100000000



LowVolumeMic					
NumPixels	MaximumDepth	ronsCubed	EquivDiameter	CentroidRow	CentroidColumn
13446	-43.0499	-75789.9463	130.843	484.222222	207.32545

Montage D2 Section 5: Cubic Volume

Ranking: 4. Deepest Pit Ranking: 10



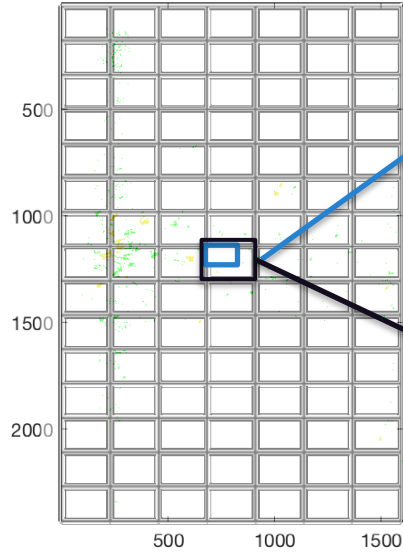
Detail of D2 Section 5

Montage results

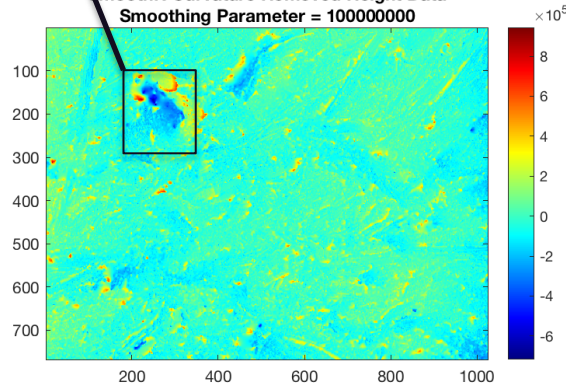
NumPixels	MaximumDepth	LowVolumeMicro onsCubed	EquivDiameter	CentroidRow	CentroidColumn
398	-44.473791	-59592.976	22.5110937	739.746231	1008.27638

Individual 20x image is located at Y7 X4.

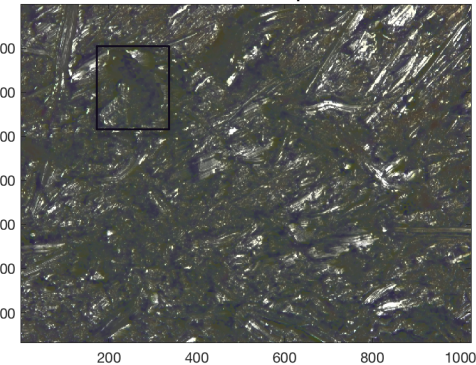
NumPixels	MaximumDepth	LowVolumeMicro onsCubed	EquivDiameter	CentroidRow	CentroidColumn
9015	-70.09162	-95526.401	107.136616	257.478092	199.299945



FY15_DE08_SW_D2_Zone_3_Section_5_Y7_X4.vk4
SmoothN Curvature Removed Height Data
Smoothing Parameter = 100000000



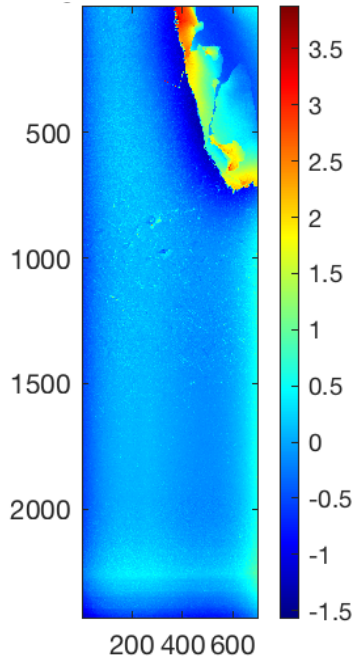
FY15_DE08_SW_D2_Zone_3_Section_5_Y7_X4.vk4
Red Green Blue Laser Optical Data



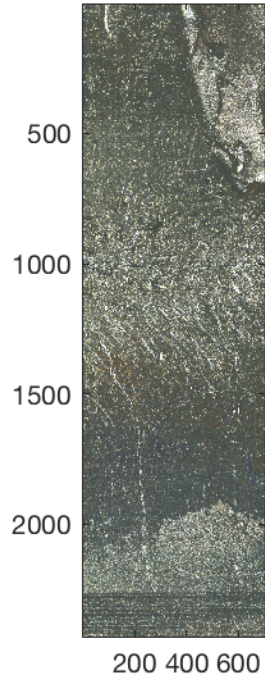
Montage D2 Section 13

Cubic Volume Ranking 7; Deepest Pit Ranking: 1

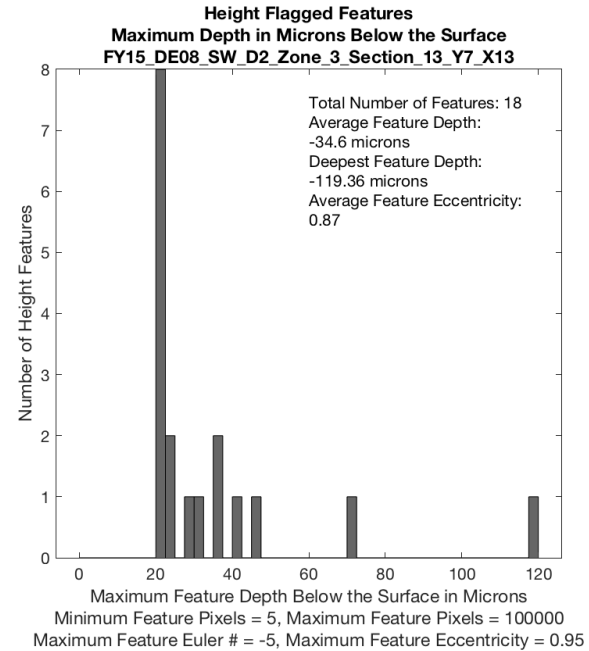
Height Data



Laser Optical

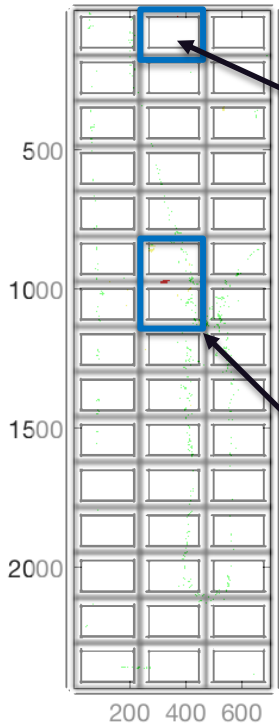


Flagged Height Features

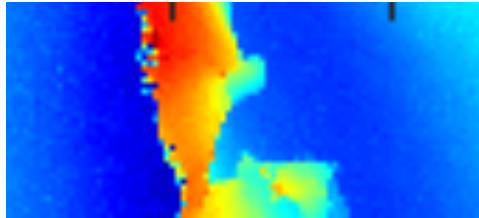


Detail for D2 Section 13

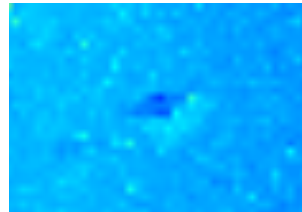
Montage analysis results



NumPixels	MaximumDepth	LowVolumeMicronsCubed	EquivDiameter	CentroidRow	CentroidColumn
21	-119.35938	-13335.188	5.1709	373.238	18.619



NumPixels	MaximumDepth	LowVolumeMicronsCubed	EquivDiameter	CentroidRow	CentroidColumn
388	-70.452746	-81632.951	22.226	325.796	973.727



There are 45 individual 20x (15 rows and 3 columns) images that make up the montage of D2 Section 13.

Flagged Features

Red > 50 micron depth

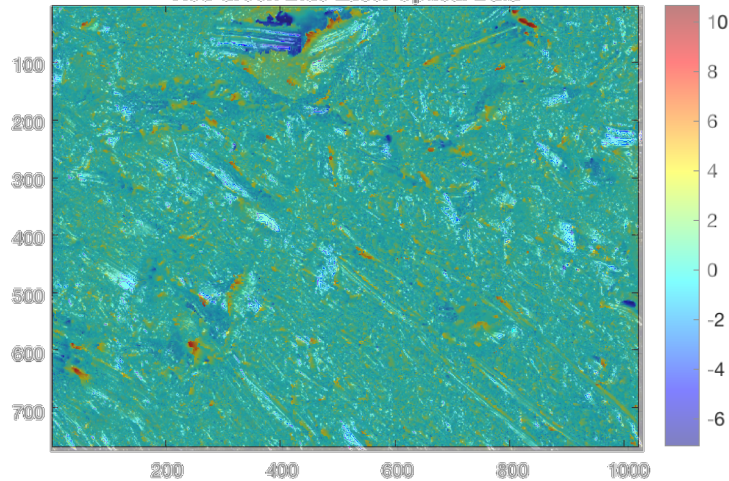
Yellow <50, >20

Green <20, >10

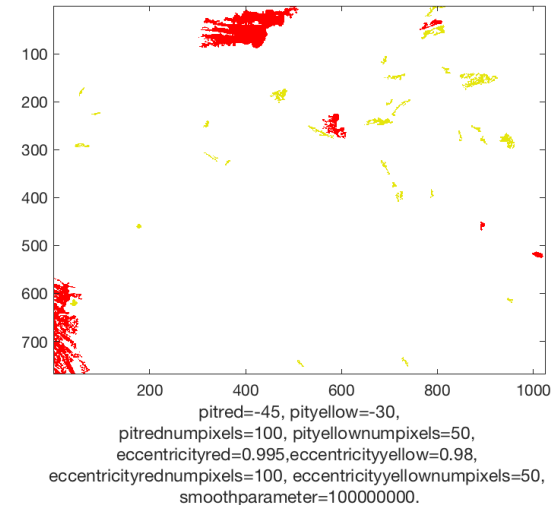
Detail for D2 Section 13; Individual 20x image

NumPixels	MaximumDepth	LowVolumeMicronsCubed	EquivDiameter	CentroidRow	CentroidColumn
8612	-85.806904	-125122.956	104.714559	401.163725	46.4311426

FY15_DE08_SW_D2_Zone_3_Section_13_Y7_X2.vk4
Red Green Blue Laser Optical Data



Height Flagged Features Below the Surface (Red or Yellow)
FY15_DE08_SW_D2_Zone_3_Section_13_Y7_X2

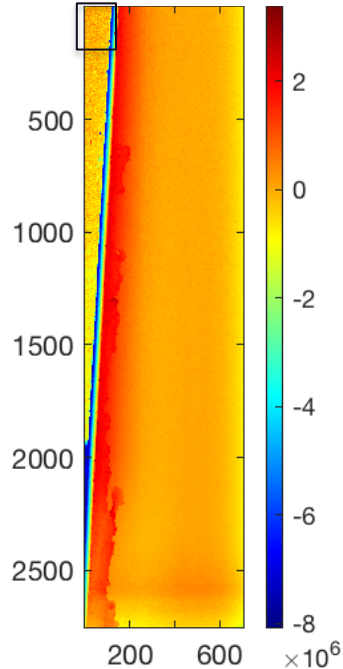


The feature of interest is located at the top of the individual 20x image. There is a lot of noise in the image. The depth is 85 microns compared to 70 microns.

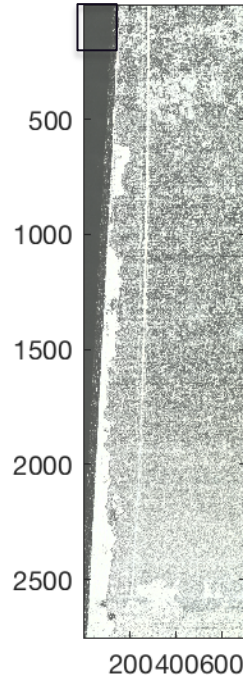
Montage B2 Section 1

Cubic Volume Ranking: 5, Deepest Pit Ranking: 2

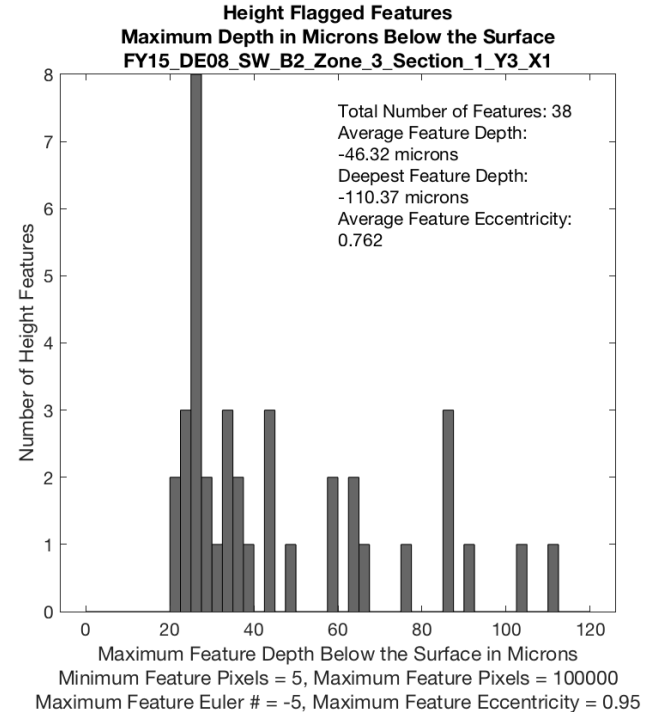
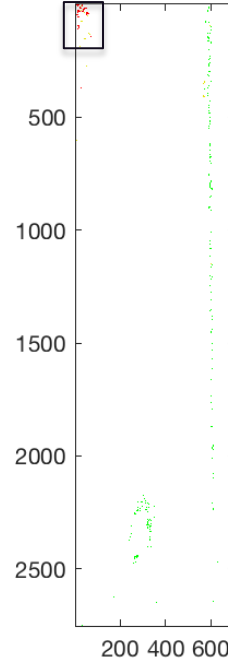
Height Data



Laser Optical



Identified features

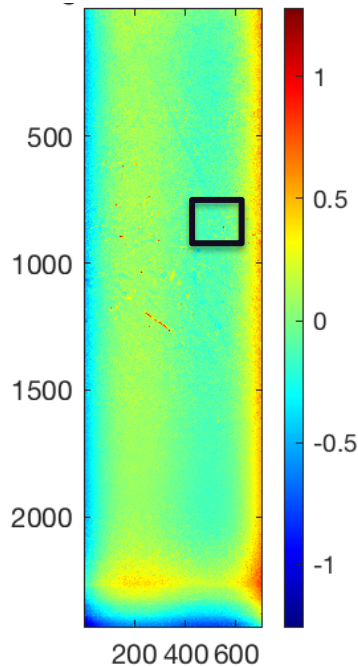


The features identified as deep are off sample, all red (>50 microns) features are in the left hand corner.

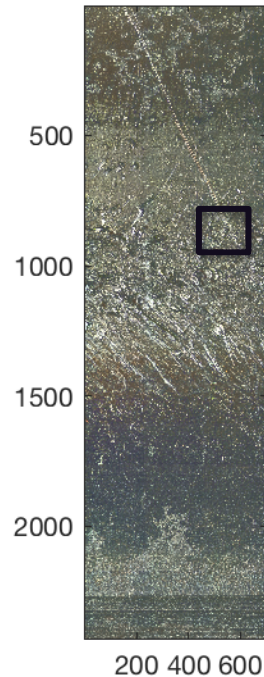
Montage D2 Section 12

Cubic Volume Ranking: 6, Deepest Pit Ranking: 4

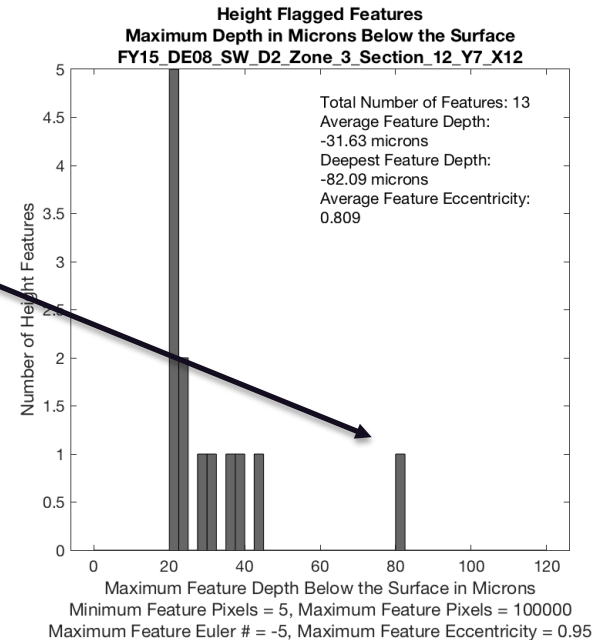
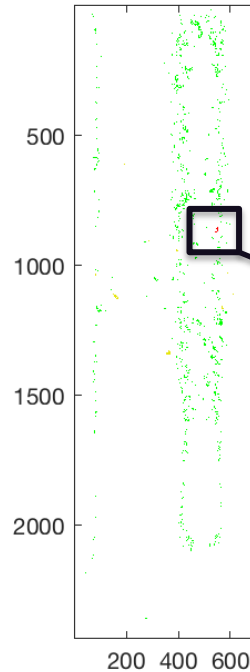
Height Data



Laser Optical



Flagged features

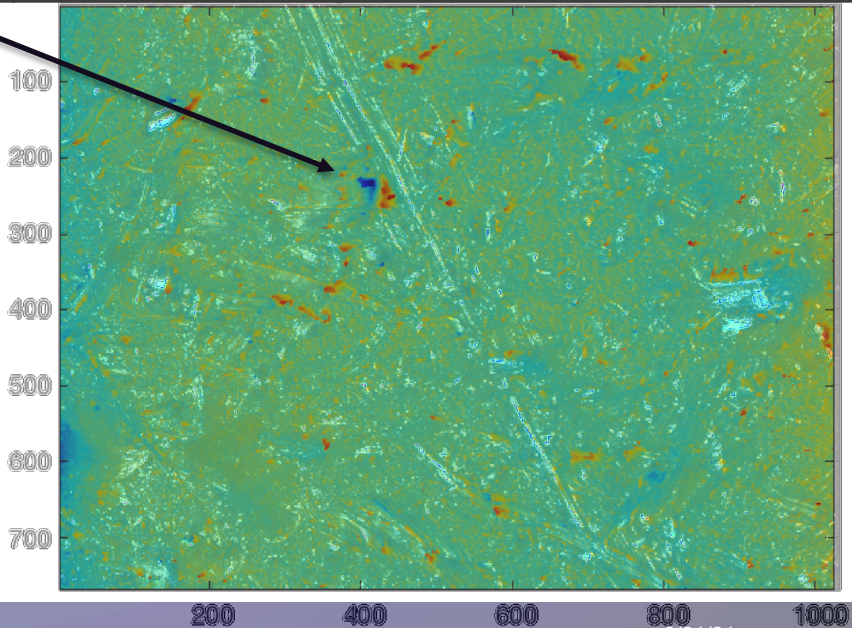
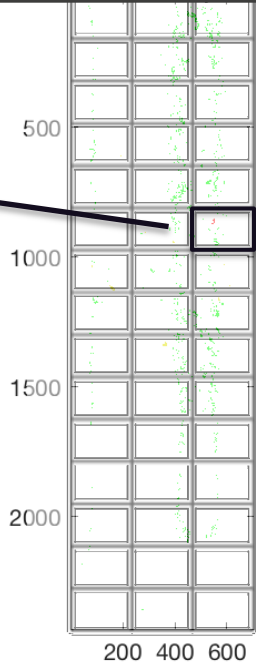
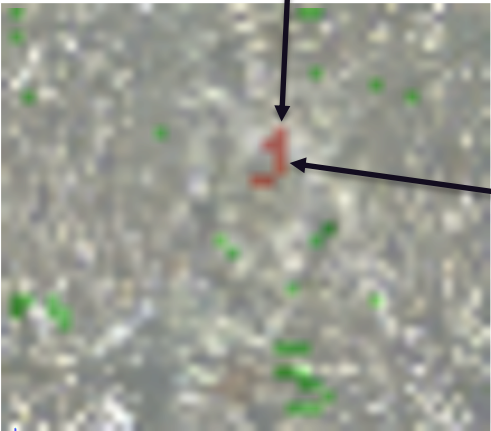


Montage image feature information

NumPixels	MaximumDepth	LowVolumeMicroscopyCubed	EquivDiameter	CentroidRow	CentroidColumn
112	-82.095	-21519.137	11.942	548.964	863.563

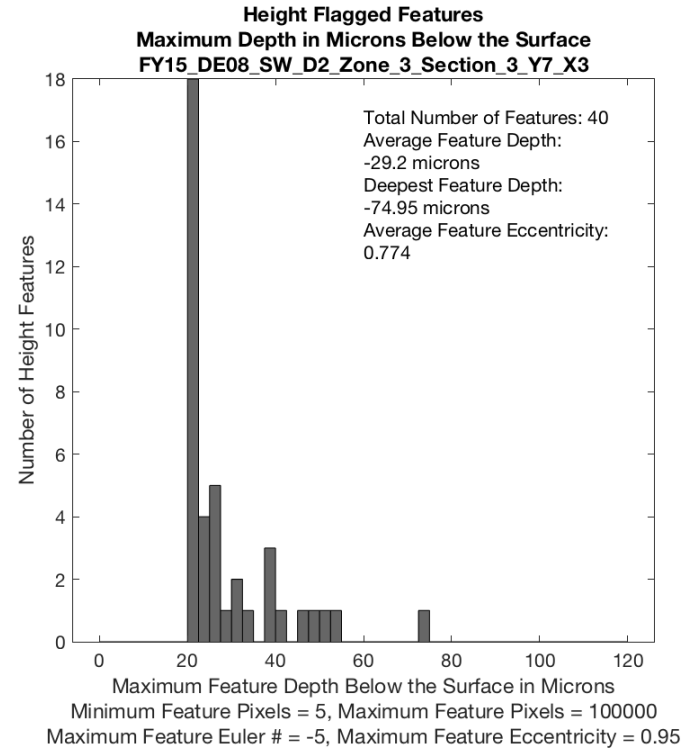
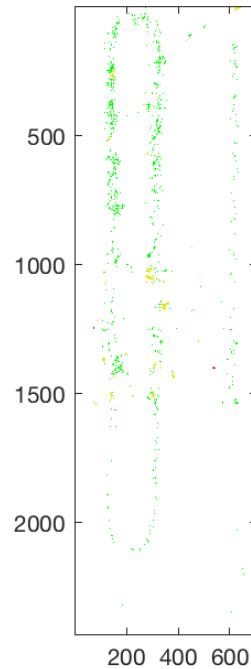
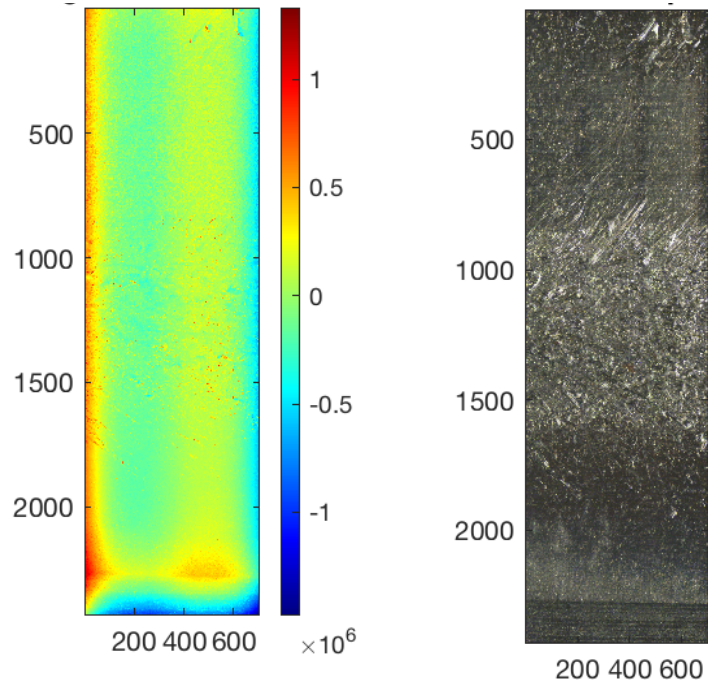
Individual 20x image

NumPixels	MaximumDepth	LowVolumeMicroscopyCubed	EquivDiameter	CentroidRow	CentroidColumn
669	-89.810067	-12192.954	29.1856	410.4858	239.139

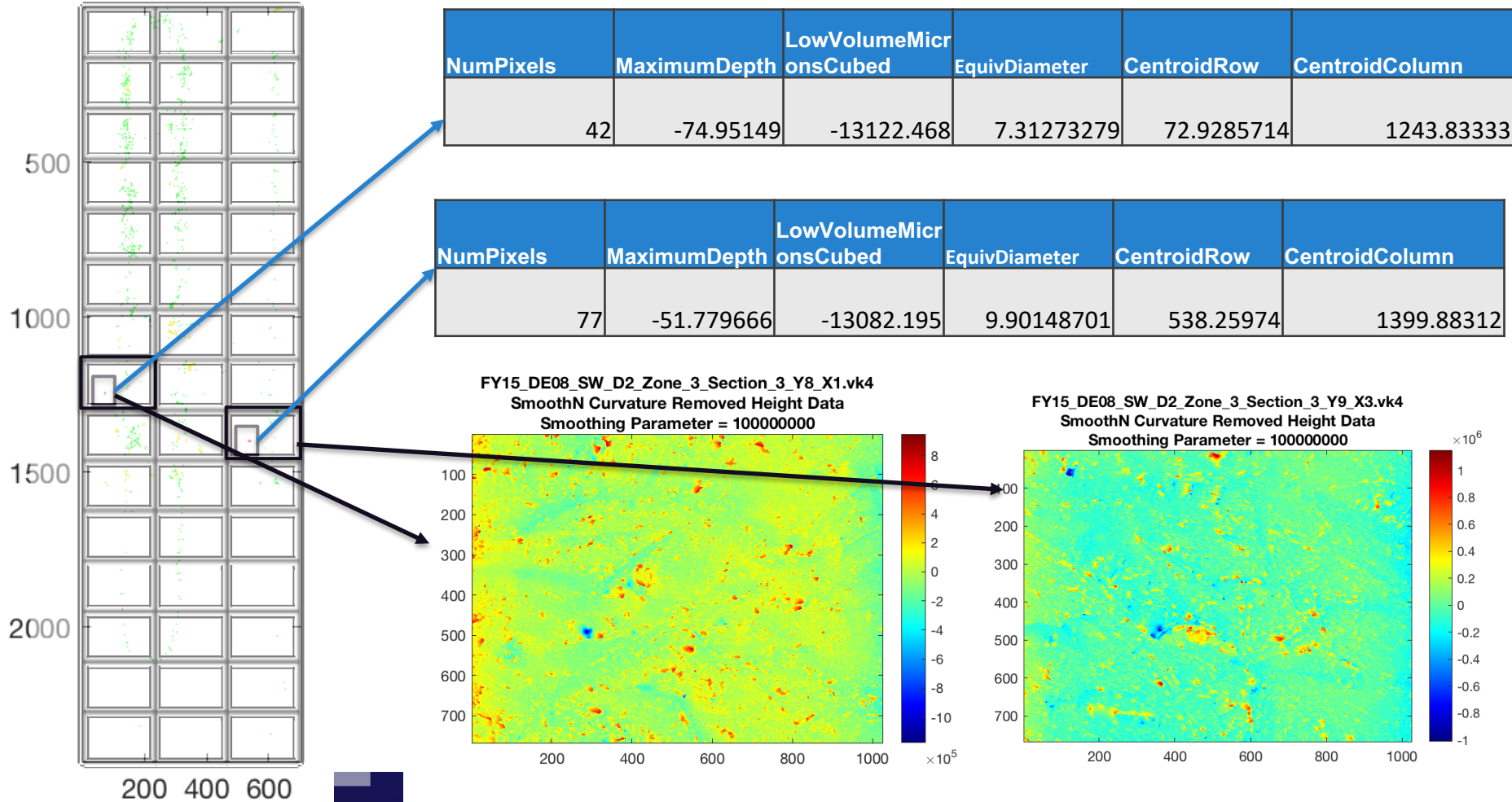


Montage D2 Section 3

Cubic Volume Ranking: 8, Deepest Pit Ranking: 5

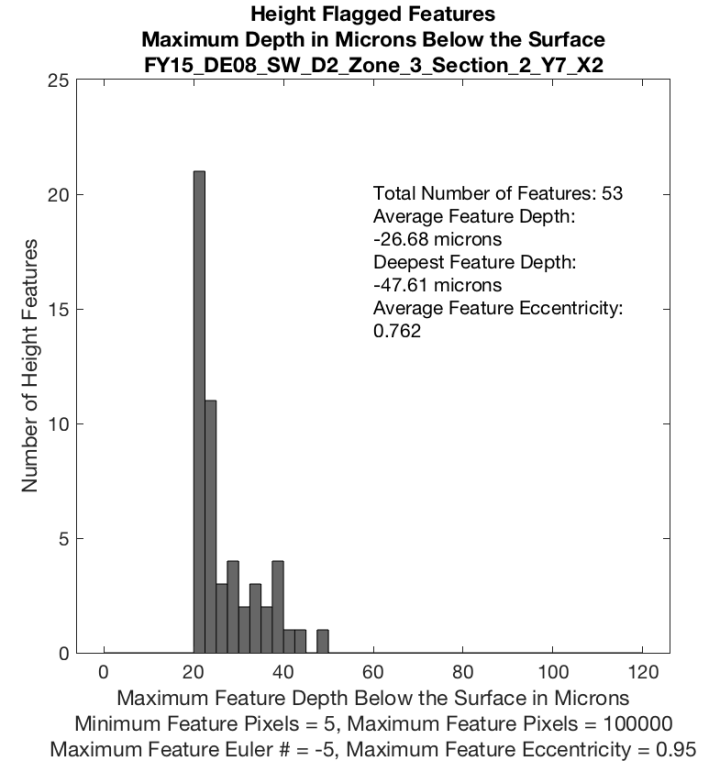
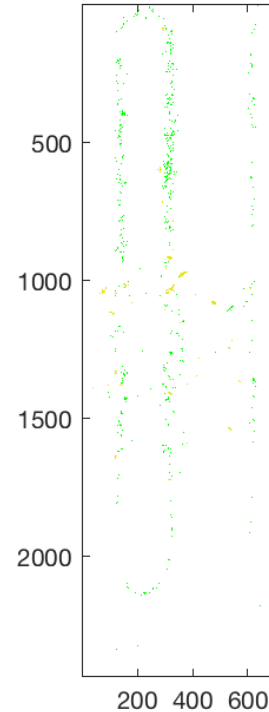
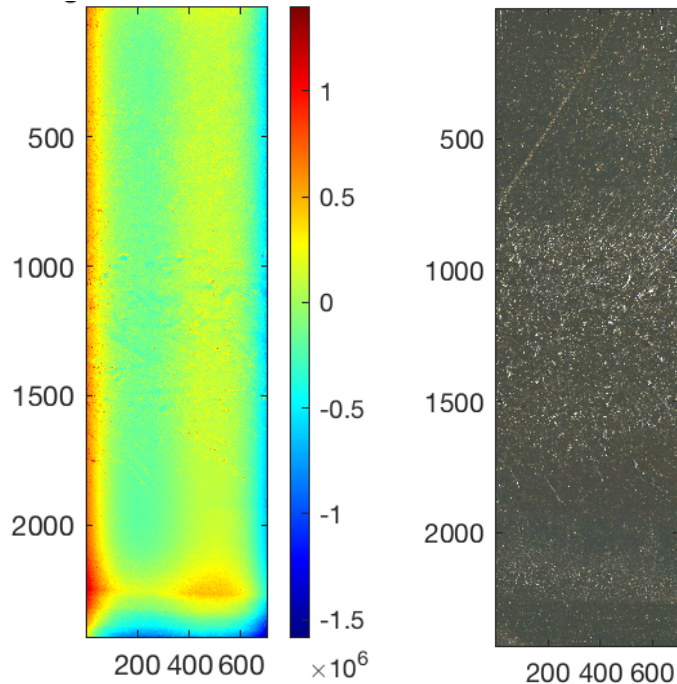


Detail view of D2 Section 3



Montage D2 Section 2

Cubic Volume Ranking: 9, Deepest Pit Ranking: 8



Montage A1 Section 2

Cubic Volume Ranking: 10, Deepest Pit Ranking: 9

